Declaration

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Osaka, this 2nd day of July , 2002

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[Title of Invention] DIGITAL IMAGE PADDING METHOD AND DECODING APPARATUS

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[Attached Documents]

[Name of Document]	Specification	1
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[Name of Document] Specification

[Title of the Invention] Digital Image Padding Method and Decoding Apparatus

[Claims]

[Claim 1] A digital image padding method wherein an original image having an arbitrary shape and comprising significant and insignificant samples, is resampled every (N + 1)-th sample (N =0, 1, 2, ···) in a predetermined direction to generate (N + 1) small images, and

in the n-th small image (n = 1, 2, ···, N + 1), padding values which are determined by a predetermined method replace values of the insignificant samples.

[Claim 2] A digital image padding method wherein an original image having an arbitrary shape and comprising significant and insignificant samples, is resampled every (N + 1)-th sample (N =0, 1, 2, ···) in a predetermined direction to generate (N + 1) small images, and

in the n-th small image (n = 1, 2, ···, N + 1), padding values which are determined by a predetermined method replace values of the insignificant samples, and the n-th padded small image is generated, and

the samples of the (N + 1) padded small images are rearranged so as to have the same arrangement as that of the samples of the original image.

[Claim 3] A digital image padding method according to claim

1 or claim 2 wherein the padding values in the n-th small image are calculated by the use of values of the significant samples in the n-th small image.

[Claim 4] A digital image padding method wherein every other sample in an original image having an arbitrary shape and comprising significant and insignificant samples, is resampled in the vertical direction to generate first and second small images, and

for the first small image, padding values determined by a predetermined method replace values of the insignificant samples, and for the second small image, padding values determined by a predetermined method replace values of the insignificant samples.

[Claim 5] A digital image padding method wherein an original image having an arbitrary shape and comprising significant and insignificant samples, is divided into a first image comprising only samples on odd lines and a second image comprising only samples on even lines,

for the first small image, padding values are generated by the use of the significant samples in the first small image and replace values in the insignificant samples, and

for the second small image, padding values are generated by the use of the significant samples in the second small image and replace values of the insignificant samples.

[Claim 6] A digital image padding method wherein for an original image having an arbitrary shape and comprising significant and insignificant samples, padding values determined by a

predetermined method replace values of the insignificant samples, and

when determining a padding value, the padding value is generated by the use of a value of a significant sample which is N (N = 0, 1, 2, ···) samples apart from an insignificant sample to be padded.

[Claim 7] A digital image padding method wherein for an original image having an arbitrary shape and comprising significant and insignificant samples, padding values determined by a predetermined method replace values of the insignificant samples, and

when determining a padding value, the padding value is generated by the use of a value of a significant sample which is, in the vertical direction, one sample apart from an insignificant sample to be padded.

[Claim 8] A digital image decoding apparatus comprising an input means, a data analyzer, a decoder, an adder, a padding unit and a frame memory, wherein

compressively coded data is input to the input means,

the compressively coded data is analyzed in the data analyzer to output a compressed difference signal and a sample identifier,

in the decoder, the compressed difference signal is restored to be a decompressed difference signal,

in the adder, the decompressed difference signal and a prediction signal obtained from the frame memory are added to

provide and output a reproduced signal, and

in the padding unit, according to the sample identifier, the samples of the reproduced signal are rearranged before the insignificant samples are padded and stored in the frame memory.

[Claim 9] A digital image decoding apparatus comprising an input means, a data analyzer, a decoder, an adder, a padding unit and a frame memory, wherein

compressively coded data is input to the input means,

the compressively coded data is analyzed in the data analyzer to output a compressed difference signal and a sample identifier,

in the decoder, the compressed difference signal is restored to be a compressed difference signal,

in the adder, the decompressed difference signal and a prediction signal obtained from the frame memory are added to provide and output a reproduced signal, and,

in the padding unit, according to the sample identifier, the insignificant samples of the reproduced signal are padded frame by frame or field by field, and stored in the frame memory.

[Claim 10] A digital image decoding apparatus comprising an input means, a data analyzer, a decoder, an adder, a prediction image generating unit, a padding unit and a frame memory, wherein

compressively coded data is input to the input means,

the compressively coded data is analyzed in the data analyzer to output a compressed difference signal and a sample identifier,

in the decoder, the compressed difference signal is restored

to be a decompressed difference signal,

in the prediction image generating unit, a prediction signal is obtained from the frame memory,

in the padding unit, according to the sample identifier, the insignificant samples of the prediction signal are padded frame by frame or field by field to generate a padded prediction signal, and

in the adder, the decompressed difference signal and the padded prediction signal are added to provide and output a reproduced signal, and the reproduced signal is stored in the frame memory.

[Claim 11] A digital image decoding apparatus comprising an input means, a data analyzer, a decoder, an adder, a padding unit, a rearrangement unit and a frame memory, wherein

compressively coded data is input to the input means,

the compressively coded data is analyzed in the data analyzer to output a compressed difference signal and a sample identifier,

in the decoder, the compressed difference signal is restored to be a decompressed difference signal,

in the adder, the decompressed difference signal and a prediction signal obtained from the frame memory are added to provide and output a reproduced signal, and

in the padding unit, the insignificant samples of the reproduced signal are padded by a predetermined method to provide a padded reproduced signal, and

in the rearrangement unit, according to the sample identifier, the padded reproduced signal is rearranged and then stored in the frame memory.

[Detailed Description of the Invention]

[0001]

[Applicable Field in Industry]

This invention relates to a method for padding a digital image having an arbitrary shape and a coding/decoding apparatus for a digital image using the padding method, and particularly, to a padding method for an interlacing-scanned image.

[0002]

[Prior Art]

Compressive coding is required to store or transmit a digital image efficiently. As a method of compressive coding of a digital image, there are waveform coding methods such as subband, wavelet and fractal, other than discrete cosine transform (DCT) typical of JPEG and MPEG. Moreover, to remove redundant signals between images, prediction between images by using motion compensation is conducted and difference signals are subjected to the waveform coding. In an interlacing scanned image such as image signals of the television now in use, a frame is composed of an odd field and an even field, and depending on size of motion, the correlation between scanning lines is high or is low. When the correlation between scanning lines is high, an image is subjected to the motion compensation and the waveform coding frame by frame. When the

correlation is low, an image is divided to an odd field and an even field and then each field is subjected to the motion compensation and the waveform coding.

[0003]

Recently, objects composing an image are compressively coded and transmitted separately so that compression efficiency is improved and object-by-object reproduction is realized. At a reproducing reproduction, each object is decoded, and the reproduced objects are composited to display the image.

[0004]

As a result of coding object by object, moving images are easily reorganized by combining objects freely to be composited. Moreover, even when relatively unimportant images are not reproduced depending on degrees of congestion of transmission lines, the performance of a reproducing apparatus, or preference of an audience, it is possible to watch moving images.

[0005]

To encode an image (an object) having an arbitrary shape, the image is subjected to a transform method adapted to the shape, for example, shape adaptive discrete cosine transform, or the ineffective regions of the image (regions outside the object and comprising only so-called insignificant sample values which do not have pixel data for displaying the object) are padded by a predetermined method and are subjected to a conventional 8 x 8 cosine transform. On the other hand, a prediction region (for example,

a block comprising 16 x 16 pixels) obtained by subjecting a reference image, which was reproduced in the past of a temporal direction, to the motion compensation so as to remove redundant signals between images, contain insignificant sample values. When the difference between the prediction region containing the insignificant sample values and a target region to be coded is calculated, the insignificant sample values are not always optimal prediction values (in terms of the smallness of errors). Therefore, the difference value is liable to be very large.

[0006]

A prediction region including insignificant sample values is once padded with padding values in a way to reduce the difference between the prediction region and the target region, and then the difference is calculated to generate the prediction error signal which is subjected to transform coding. The padding of the prediction region suppresses the difference signal. In the prior art, as a padding value to pad an insignificant sample, the average of significant sample values horizontally and vertically adjacent to the insignificant sample is used. The use of the horizontal and vertical average suppresses the high frequency component of the padded region, thereby increasing the coding efficiency.

[0007]

[Problems to be Solved by the Invention]

However, when the method for calculating the average of the horizontally and vertically adjacent significant sample values is

applied to the interlacing scanned image, high frequency components increase problematically. In the interlacing-scanned image, the correlation between the samples of immediately adjacent lines is reduced, especially when motion is great. Figure 3 shows a diagram of this case. Squares in an image 301 indicate samples of the image. Squares (for example, a square 302) which are not painted represent insignificant samples, and squares (for example, squares 303 and 304) which are painted represent significant samples. Numerals which are written in each square indicate the values of samples. In the interlacing scanned image, since the odd field and the even field differ in the scan time, when the motion of an object is great and the frame is formed by combining these fields, a part of object seems to be out of place as shown in figure 3. For example, the sample 304 is adjacent to insignificant samples which are above and below it.

[0008]

Figure 13 and figure 14 show the result of padding the image in figure 3 according to a prior art method. In the prior art method, the padding is carried out in three steps. In the first step, the significant samples of an image are extended in the horizontal direction, and the result is extended in the vertical direction. In the second step, the significant samples of the same image are extended in the vertical direction, and the result is extended in the horizontal direction. In the third step, the results of the first and second steps are averaged. The image 301 in figure 3

becomes an image 350 in figure 13 after the process in the first step. Initially, on rows (rows 354 to 359) containing significant samples, the significant samples are extended. The remaining rows 352 and 353 extend the padded samples on the row 354 upwardly. Thereafter, the image 301 in figure 3 becomes an image 351 in figure 13 after the process in the second step. Initially, on columns (a column 362 to a row 365) containing significant samples, the significant samples are extended. The remaining columns 360 and 361 extend the padded samples on the column 362 leftward. Similarly, the columns 367 and 368 extend the samples on the padded column 365 rightward. Averaging the samples in the images 350 and 351 results in an image 380 in figure 14. When the image 380 is divided into odd fields and even fields, as shown in images 381 and 382, the sample values on each field are nonuniform, which introduces high frequency components. Similarly, a non-interlacing scanned image often has a striped pattern, and the image is subjected to resampling before coding. When such an image is padded by the prior art method, high frequency components are introduced into the resampled image, thereby reducing the coding efficiency. There is the same problem in other method where padding values are obtained by the use of horizontally and vertically adjacent significant samples.

[0009]

It is an object of this invention to efficiently pad an interlacing-scanned or striped pattern image having an arbitrary

shape, and thereby increase the coding efficiency.

[0010]

[Measures to Solve the Problems]

A solution to these problems is to provide a first digital image padding method wherein an original image having an arbitrary shape and comprising significant and insignificant samples, is resampled every (N + 1)-th sample (N = 0, 1, 2, ···) in a predetermined direction to generate (N + 1) small images, and in the n-th small image (n = 1, 2, ···, N + 1), padding values which are determined by a predetermined method replace the values of the insignificant samples.

[0011]

A second digital image padding method of this invention wherein a padding value which is determined by a predetermined method replaces the value of an insignificant sample for an original image having an arbitrary shape and comprising significant and insignificant samples, and when determining a padding value, the padding value is generated by the use of a significant sample which is positioned N (N = 0, 1, 2, ···) samples apart from the insignificant sample to be padded.

[0012]

A first digital image decoding apparatus using the digital image padding method of this invention comprising an input means, a data analyzer, a decoder, an adder, a padding unit and a frame memory, wherein compressively coded data is input to the input means,

and the compressively coded data is analyzed by the data analyzer to output a compressed difference signal and a sample identifier, and the compressed difference signal is restored to be a decompressed difference signal by the decoder, and the decompressed signal and a prediction signal obtained from the frame memory are added to provide and output a reproduced signal, samples of which are rearranged according to the sample identifier and insignificant sample values therein are padded by the padding unit, and then stored in the frame memory.

[0013]

A second digital image decoding apparatus using the digital image padding method of this invention comprising an input means, a data analyzer, a decoder, an adder, a prediction image generating unit, a padding unit and a frame memory, wherein compressively coded data is input to the input means, and the compressively coded data is analyzed by the data analyzer to output a compressed difference signal and a sample identifier, and the compressed difference signal is restored to be a decompressed difference signal by the decoder, the insignificant samples contained in a prediction signal obtained from the frame memory in the prediction image generating unit, are padded frame by frame or field by field according to the sample identifier by the padding unit to generate a padded prediction signal, the decompressed difference signal and the padded prediction signal are added by the adder to provide and output a reproduced signal, which is stored in the frame memory.

[0014]

[Embodiments]

Embodiments of this invention are described referring to figure 1 to figure 12, as follows.

[0015]

(Embodiment 1)

Figure 1 is a first flowchart for showing a digital image padding method according to a first embodiment of this invention. An image is input in step 101. Here, an image having an arbitrary shape is processed, and it may be a interlacing-scanned image or a non-interlacing scanned image. Or, the image is divided into plural region adjacent to each other (for example, a block comprising N x M samples), the respective regions may be input one by one in step 101. Figure 3 shows an example of the image 301 to be processed. The squares of the image 301 represent the samples of the image. A square (for example, the square 302) which is not painted indicates an insignificant sample, and a square (for example, squares 303 and 304) which is painted represents a significant sample. Numerals which are written in each square indicate the value of each sample. The non-interlacing scanned image sometimes has such an object as shown in figure. Or in the non-interlacing scanned image, when motion of an object is great, a part of the object seem to be out of place.

[0016]

In step 102, the input image is resampled, that is, samples

of the input image are rearranged by a predetermined method to generate plural small images. In this embodiment, four small images are formed by sampling every other sample in the horizontal and vertical directions. The images obtained by resampling the input image 301 in figure 3 are small images 401 to 404 shown in figure 4. To be specific, the input image is divided into the small image 401 comprising samples on odd (1st, 2nd, 3rd, 5th, ···) columns and odd rows, the small image 403 comprising samples on even (2nd, 4th, 6th, ···) columns and odd rows, the small image 402 comprising samples on odd columns and even rows, and the small image 404 comprising samples on even columns and even rows.

[0017]

In step 103, insignificant samples contained in each small image are padded with padding values which are calculated by a predetermined method. In this embodiment, the padding is carried out in three steps, like the prior art method. In the first step, the significant samples of the image are extended in the horizontal direction, and the result is extended in the vertical direction. In the second step, the significant samples of the same image are extended in the vertical direction, and the result is extended in the horizontal direction. In the third step, the results of the first and second steps are averaged. The small images 401 and 403 in figure 4 are padded to generate a small image 405, and the small images 402 and 404 are padded to generate a small image 406. Compared to the images 381 and 382 in figure 14 padded by the prior

art method, each small region comprises uniform sample values and therefore no high frequency components is introduced therein.

[0018]

In step 104, it is decided whether or not the image is last , and the process is completed or the process goes to the padding of the next image. When the image is divided into plural regions, the process goes to the padding of the next region. Note that the padding method may comprise only the first step, or a method in which the average of the significant samples of each of the above-described small images and the average of the samples on the boundary are calculated for padding, may be employed.

[0019]

Figure 2 is a second flowchart showing the digital image padding method according to the first embodiment of this invention. This is the same as figure 1, but step 106 has been added. In step 106, each small image, which is padded in step 103, is rearranged so as to have the same arrangement as that of the samples of the input image. The padded small images 405 and 406 in figure 4 are rearranged to generate an image 407. To be specific, the sample as a result of padding the small image 401 (the small image 405) is rearranged to be at a position on an odd column and an odd row, the sample as a result of padding the small image 403 (the small image 405) is rearranged to be at a position on an even column and an odd row, the sample as a result of padding the small image 402 (the small image 406) is rearranged to be at a position on an odd

column and an even row, and the sample as a result of padding the small image 404 (the small image 406) is rearranged to be at a position on an even column and an even row.

[0020]

As described above, the result of resampling every other sample is rearranged, but in general, resampling may be conducted every (N + 1)-th sample. This may be varied freely according to the striped pattern of an image.

[0021]

Figure 5 is a third flowchart showing the digital image padding method according to the first embodiment of this invention. In step 501, an image is input. In step 502, the correlation between the samples of the input image is calculated. In this embodiment, the sum of the absolute values of the differences between the samples on two adjacent odd and even columns to generate a first evaluation value. Meanwhile, the difference between the samples of two immediately adjacent even columns, and the difference between the samples of two immediately adjacent odd columns are calculated, and the sum of the absolute values of these differences is calculated, to generate a second evaluation value. In step 503, the first evaluation value is compared with the second evaluation value, and when the second evaluation value is smaller (that is, the correlation between the samples of an odd column and an even column is low), in step 504 the input image is resampled every second column to generate a small image comprising only odd columns and another

small image comprising only even columns, each of which is padded. When the second evaluation value is not smaller, the input image is not resampled but padded in step 505. For the correlation between rows, the evaluation values are similarly calculated and compared, and padding is carried out after deciding whether to resample in the vertical direction. While the correlation of samples is compared every second column (or row), in general, the correlation of samples is calculated every (N + 1)-th sample (N=2, 3, ...) and resampling and padding are carried out according to largeness of the evaluation values. Moreover, other functions may be used when calculating the evaluation value, or only significant samples may be used for the calculation.

[0022]

Figure 6 is a fourth flowchart showing the digital image padding method according to the first embodiment of this invention, and particularly, showing a process for deciding whether to pad a interlacing-scanned image field by field or frame by frame In step 601, a interlacing-scanned image is input. By way of example, the image 301 in figure 3 is input. Thereafter, the correlation between an odd line and an even line is calculated by the method described in figure 5 to generate a first evaluation value, and thereafter, the correlation between odd lines and the correlation between even lines are calculated to generate a second evaluation value, and padding is carried out by using the first or second evaluation value which has the higher correlation. That is, when

the second evaluation value is smaller in step 603, advance is made to the next step is step 604, or other wise, advance is made to step 605. In step 604, a small image comprising only odd lines and a small image comprising only even lines are generated, and each small image is padded. In step 605, the input image itself is padded frame by frame (where an odd line and an even line merge). Figure 7 shows a result obtained by padding the image 301 in figure 3 field by field. It can be observed that small images 701 and 702 are padded to generate small images 703 and 704 without introducing high frequency components.

[0023]

(Embodiment 2)

Figure 8 is a digital image padding method according to a second embodiment of this invention. A description is given of a method for padding an image without resampling the image in this embodiment. An image 801 has the low correlation between an odd line and an even line, so that the odd line and the even line are each padded separately in the above-described first embodiment. In this embodiment, a significant sample which is one sample away is used for padding. For example, when a sample 808 is padded, the value of the sample 808 which is one sample away therefrom is used for padding instead of using a sample 809. Similarly, when a sample 807 is padded after the sample 808 is padded, the value of the sample 809 which is one sample away therefrom is used for padding. The samples 803 to 808 so padded constitute the second line of the image

802. The other lines are processed in the same way. The image 802 so padded has the same effect as the case where an image is resampled before being padded. Note that a significant sample which is N samples away can be used for padding. The method is applied to the padding of rows rather than the padding of columns.

[0024]

A description is given of an embodiment in the case where the digital image padding method of this invention is applied to an image decoding apparatus.

[0025]

(Embodiment 3)

Figure 9 shows a block diagram of a first decoding apparatus using the digital image padding method of this invention. In figure 9, 901 denotes an input terminal, 902 denotes a data analyzer, 903 denotes a decoder, 904 denotes an inverse quantizer, 905 denotes an inverse discrete cosine transform unit, 906 denotes an adder, 907 denotes an output terminal, 908 denotes a frame padding unit, 909 denotes a frame memory, 910 denotes a motion compensating unit, 921 denotes a field padding unit, and 924 denotes a rearrangement unit.

[0026]

The operation of the decoding apparatus so constructed is described as follows. When compressively coded data is input to the input terminal 901, and the data analyzer 902 analyzes this data. Figure 11 shows a diagram of the input data of the decoding

apparatus of this invention. In the input data, an image synchronous signal 302 is placed at the head of data of a piece of an image 200, which is followed by a step value 204 which is used for quantization, a sample identifier 205, a motion vector 206 and a discrete cosine transform (DCT) coefficient 207. The image synchronous signal 203 indicates the head of compressed data of a piece of the image 200 and is represented by a unique 32-bit code. A quantization step value 204 is a 5-bit parameter for inversely quantizing DCT coefficients. In this embodiment, an image is divided into plural regions before being coded. It is preferable to divide the image into blocks each comprising 16 x 16 samples, and each block is divided into four blocks each comprising (8 x 8) samples when subjected to DCT. As shown in the figure, for each block, there are a sample identifier, a motion vector and DCT coefficients. In figure 12, there is shown an example of a block 250 comprising (16 x16)samples. Lines which are not painted by oblique lines indicate a field 1, while lines which are painted out by oblique lines indicate a field 2. When the correlation between the fields in the interlacing-scanned image is high, the block is divided into four small blocks each comprising (8 x 8) samples (255 to 258), which are subjected to DCT, while when the correlation in the fields is high, it is rearranged into the fields 1 and 2 and then divided into four blocks each comprising (8 x 8) samples (251 to 254), which are subjected to the DCT. A sample identifier is a parameter for identifying this. In this

embodiment, 1 indicates that the correlation in the fields is high. Moreover, all blocks can share the same identifier. In this case, an image is separated into the field 1 and the field 2, and then blocked and coded.

[0027]

The data analyzer 902 analyzes the input data and output the result as data of difference blocks, into which the quantization steps and the DCT coefficients have been compressed, to the decoder 903 through the line 912. Motion vectors are sent to the motion compensating unit 910 through the line 918, and sample identifiers are sent through the line 920. In the decoder 903, the compressed difference block is decompressed, and restored to be a decompressed block. In this embodiment, the decompressed difference block is inversely quantized by the inverse quantizer 904, and a frequency domain signal is converted to a spatial domain signal by the inverse discrete cosine transform unit IDCT (905). In the motion compensating unit 910, an address is generated to access the frame memory 909 based on a motion vector transmitted through the line 918, and a prediction block is generated from an image stored in the frame memory 909. The prediction block and the decompressed difference block are input to the adder 906, and are added to provide a reproduced block. The reproduced block is output to the output terminal 907 and to a switch 922.

[0028]

The switch 922 is connected to the frame padding unit 908

or the field padding unit 921, which is controlled by the sample identifier transmitted through the line 920. As described above, the sample identifier indicates whether the correlation in the field is high or not. When the sample identifier is 1, the correlation in the field is high and the switch 922 is connected to the field padding unit 921 and padding is carried out field by field. In figure 12, the small blocks 251 and 252 are padded together, and the small blocks 253 and 254 are padded together. When the sample identifier is not 1, switch 922 is connected to the frame padding unit 908 and padding is carried out in the frame. The small blocks 255 to 258 in figure 12 are padded together. So padded block is sent to the pixel rearranging unit 924 through the switch 923. For the blocks padded field by field, the field 1 and the field 2 are merged and rearranged. That is, the small blocks 251 to 254 in figure 12 are rearranged into the block 250. The block thus rearranged is sent through the line 916 and stored in the frame memory 909.

[0029]

Note that in an implementation method where the reproduced block in which the field 1 and the field 2 are merged is output, it is necessary to rearrange the blocks into the field 1 and the field 2 in the field padding unit 921. Or, a significant sample which is one sample away is used for padding, which has already been explained in the second embodiment. When it is not necessary to rearrange pixels, the pixel rearrangement unit 924 may be omitted.

The field padding and the frame padding may be applied while switching these two padding, for the image coded by other waveform coding method such as wavelet and fractal.

[0030]

Figure 10 shows a block diagram of the second decoding apparatus of this invention. The basic operation is the same as that shown in figure 9. The difference is that the frame padding unit and the field padding unit are disposed at the rear of the motion compensating unit 910, instead of in front of the memory 909. For the interlacing-scanned image, the motion compensation is sometimes conducted field by field or frame by frame. When the motion compensation is conducted frame by frame, the prediction signal is obtained in a frame, while when the motion compensation is conducted field by field, the separate prediction signals are obtained from the field 1 and the field 2, respectively. In the apparatus where the motion compensation is thus conducted, the output of the motion compensating unit 910 is switched to be input to the frame padding unit 908 or the field padding unit 921 according to the sample identifier transmitted through the line 920, and the output is padded to be output to the adder 906. Moreover, an apparatus constituted by the combination of figure 9 and figure 10, may be used.

[0031]

[Effect of the Invention]

As described above, according to this invention, the image

to be padded is resampled and then padded, whereby introduction of high-frequency components is prevented, the prediction error is suppressed, and the efficiency of waveform coding is increased.

[Brief Description of Drawings]

[Figure 1]

A first flowchart showing the digital image padding method according to the first embodiment of this invention.

[Figure 2]

A second flowchart showing the digital image padding method according to the first embodiment of this invention.

[Figure 3]

A diagram of an image used for explaining the digital image coding of the embodiment of this invention.

[Figure 4]

A first diagram of an image padded by the digital image padding method according to the first embodiment of this invention.

[Figure 5]

A third flowchart showing the digital image padding method according to the first embodiment of this invention.

[Figure 6]

A fourth flowchart showing the digital image padding method according to the first embodiment of this invention.

[Figure 7]

A second diagram of an image padded by the digital image padding method according to the first embodiment of this invention.

[Figure 8]

A diagram of an image padded by the digital image padding method according to the second embodiment of this invention.

[Figure 9]

A block diagram showing the first decoding apparatus using the digital image padding method of this invention.

[Figure 10]

A block diagram showing the second decoding apparatus using the digital image padding method of this invention.

[Figure 11]

A diagram showing an input data of the decoding apparatus using the digital image padding method of this invention.

[Figure 12]

A diagram showing an image for explaining the operation of the decoding apparatus of this invention.

[Figure 13]

A first diagram showing an image padded by a prior art.

[Figure 14]

A first diagram showing an image padded by a prior art.

[Explanation of Reference Numerals]

901 input terminal

902 data analyzer

903 decoder

904 inverse quantizer

905 inverse discrete cosine transform unit

906 adder

907 output terminal

908 frame padding unit

909 frame memory

910 motion compensating unit

921 field padding unit

924 rearrangement unit

[Name of Document] Abstract

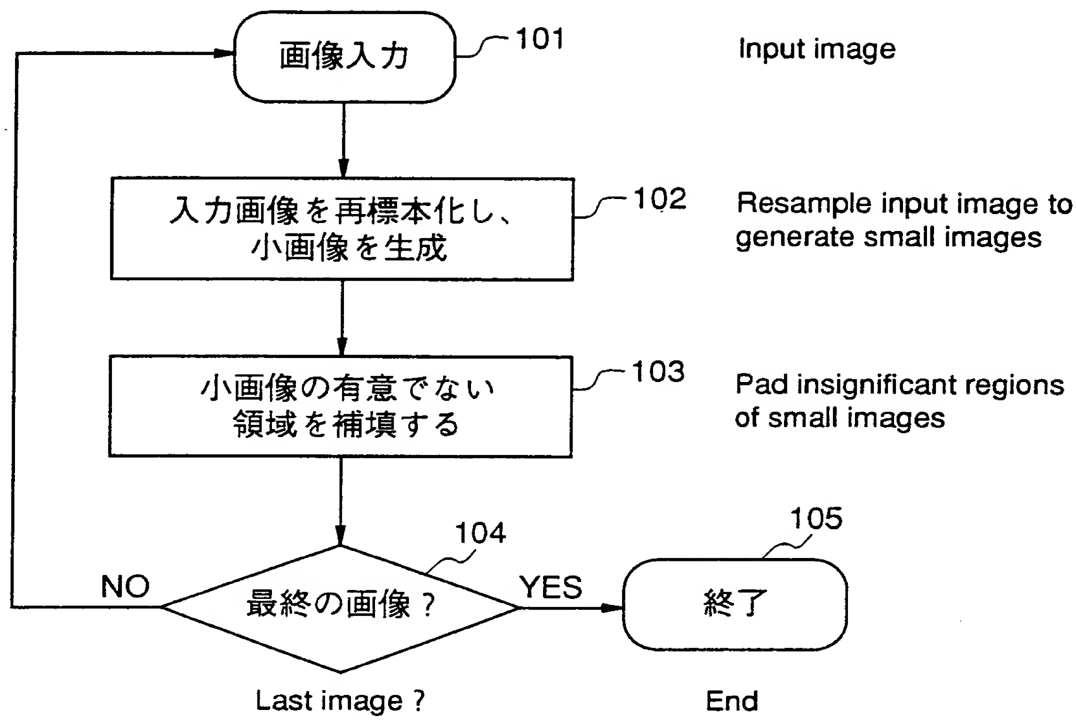
[Abstract]

[Purpose] To increase coding efficiency by efficiently padding a interlacing-scanned or striped pattern image having an arbitrary shape.

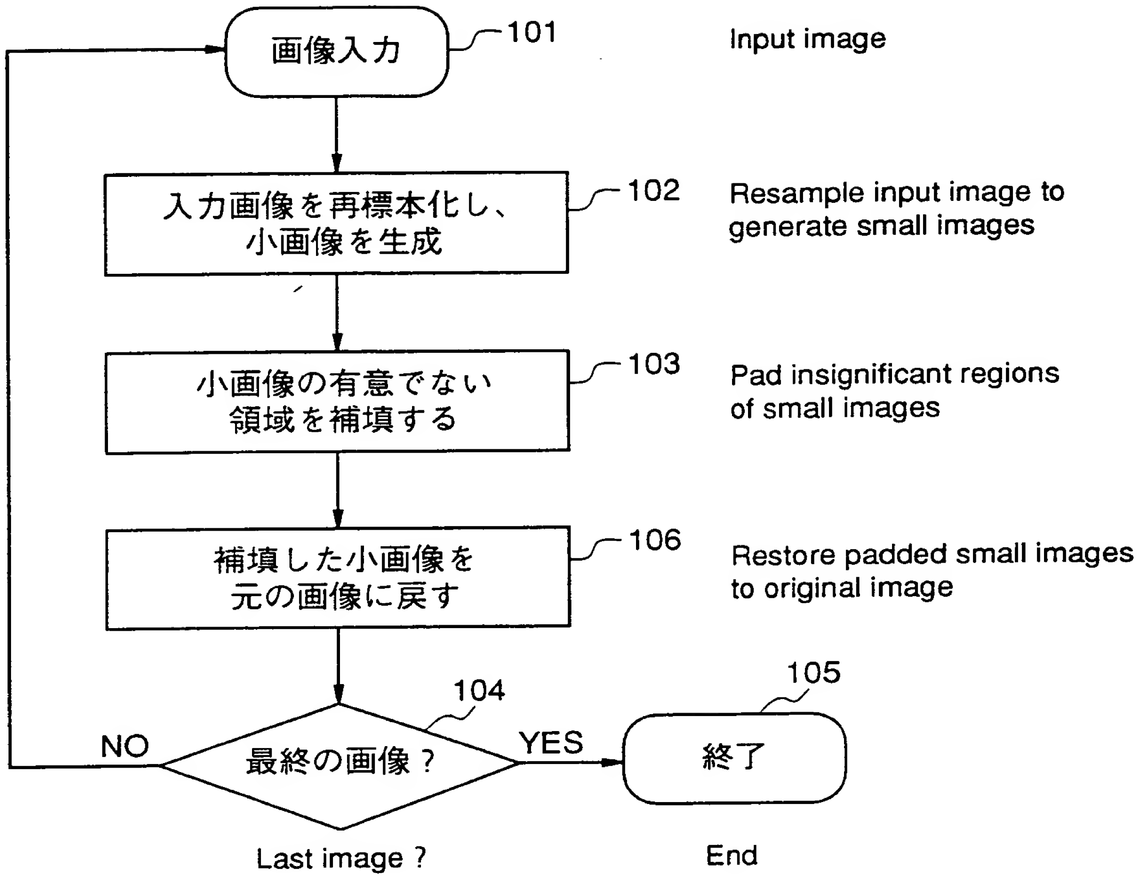
[Means to Achieve the Purpose] For an original image having an arbitrary shape which consists of significant and insignificant samples, the original image is resampled every N-th sample (N = 1, 2, ···) in a predetermined direction to generate N small images, padding values determined by a predetermined method is the values of significant samples of n-th (n = 1, 2, ···, N) image.

[Selected Figure] Figure 1

Name of Document
【書類名】　図面　Drawing
【図1】　Figure 1

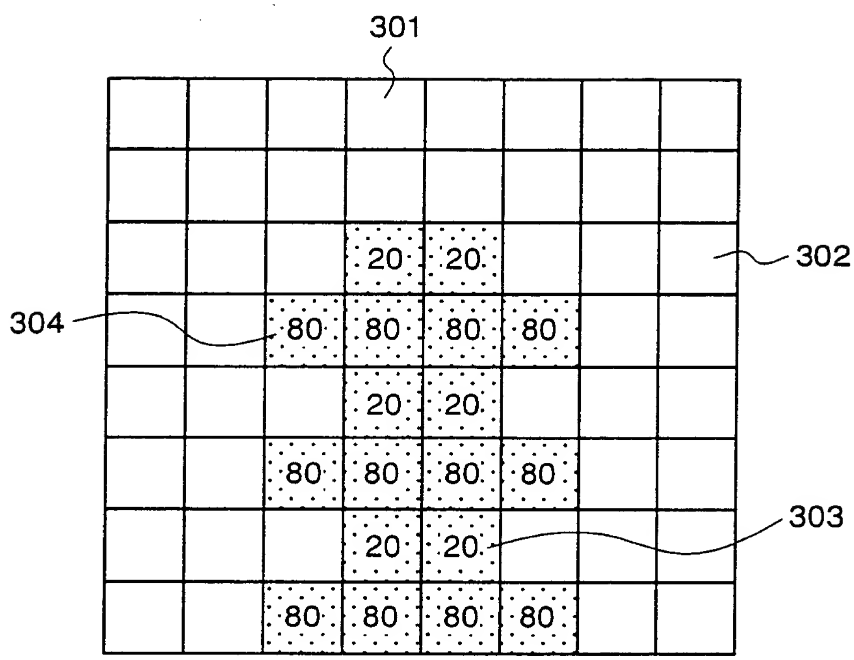


【図2】 Figure 2

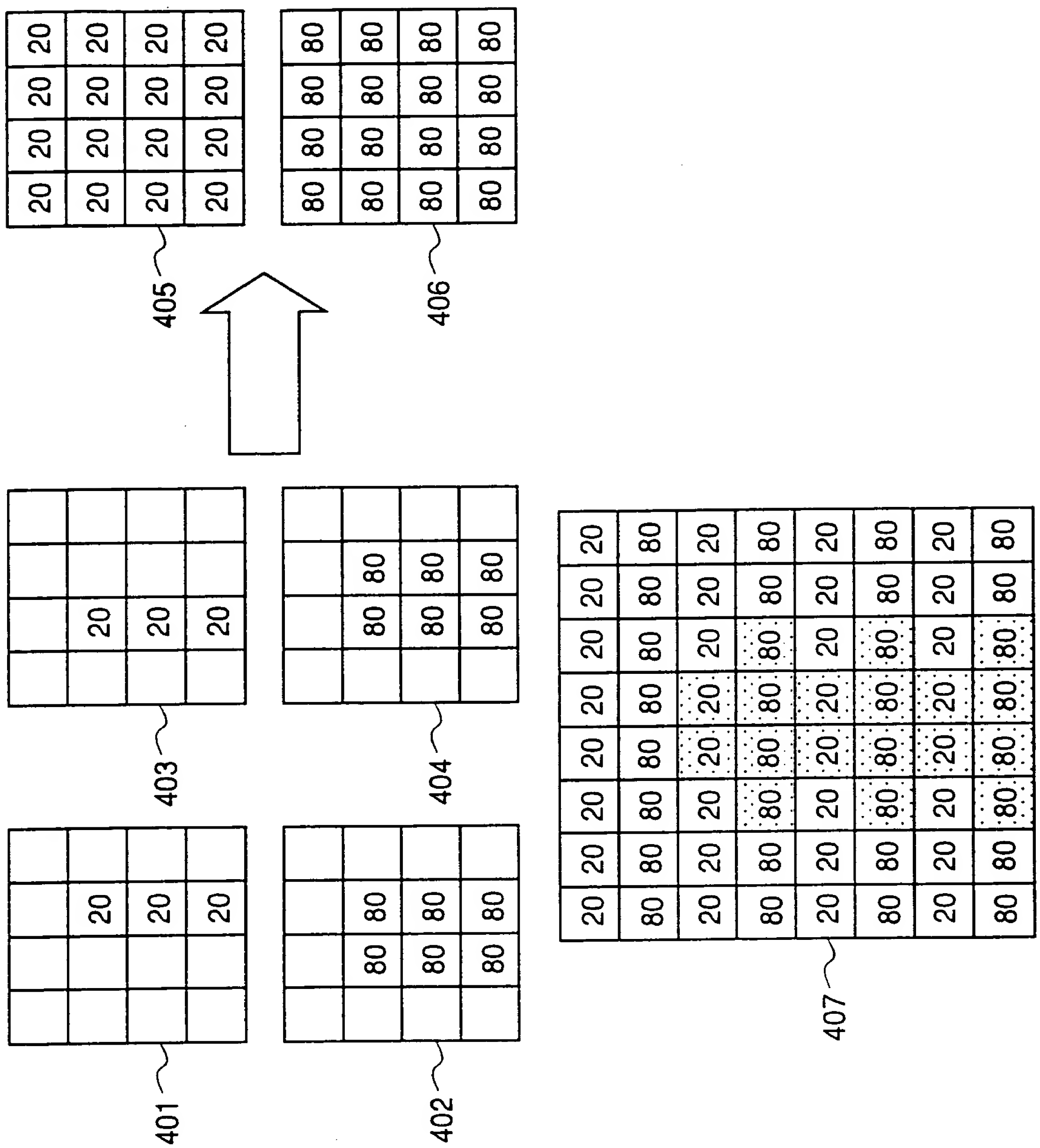


画像入力
101
Input image
入力画像を再標本化し、
小画像を生成
102
Resample input image to
generate small images
小画像の有意でない
領域を補填する
103
Pad insignificant regions
of small images
補填した小画像を
元の画像に戻す
106
Restore padded small images
to original image
104
105
NO
最終の画像？
YES
終了
Last image ?
End

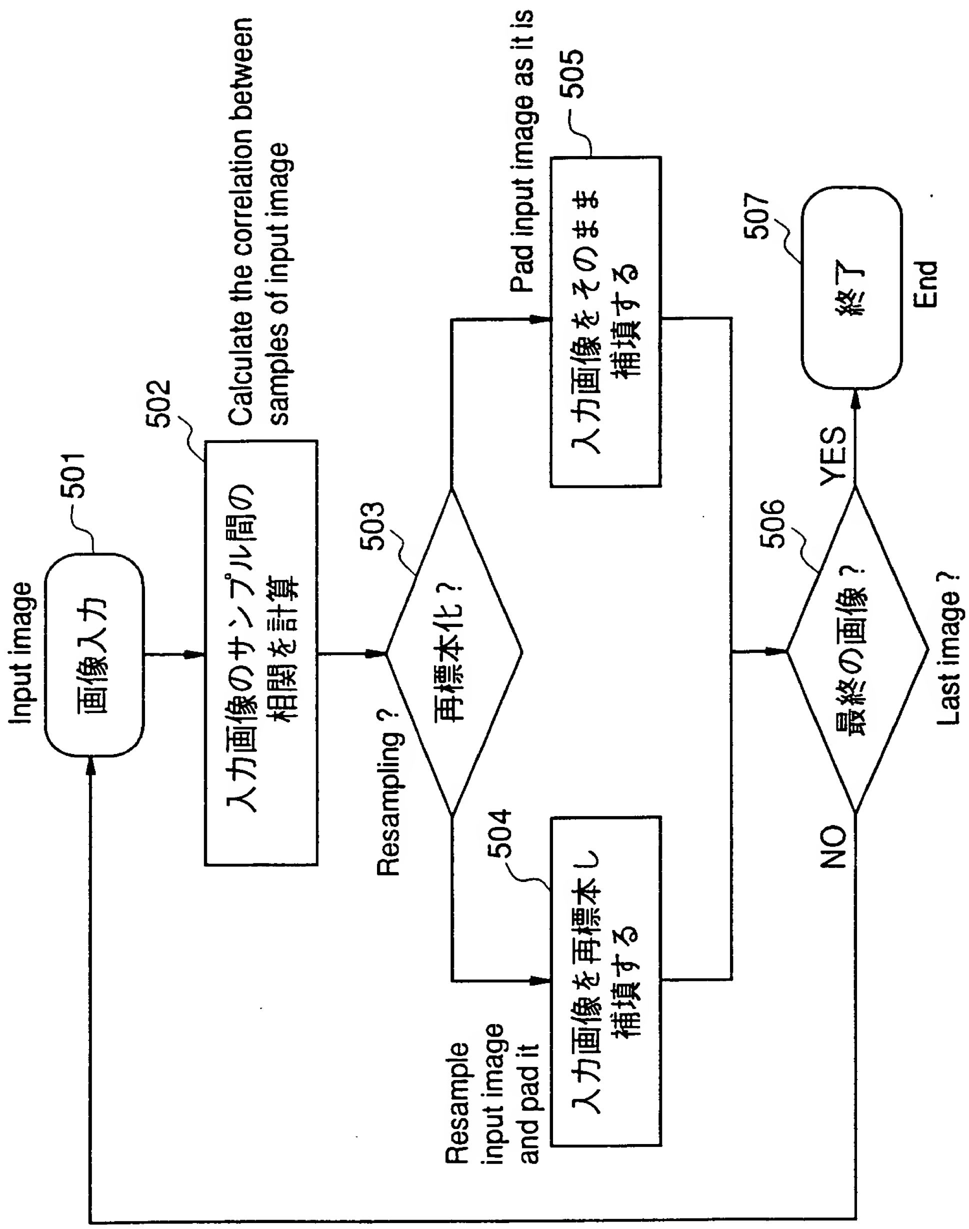
【図3】 Figure 3



【図4】 Figure 4

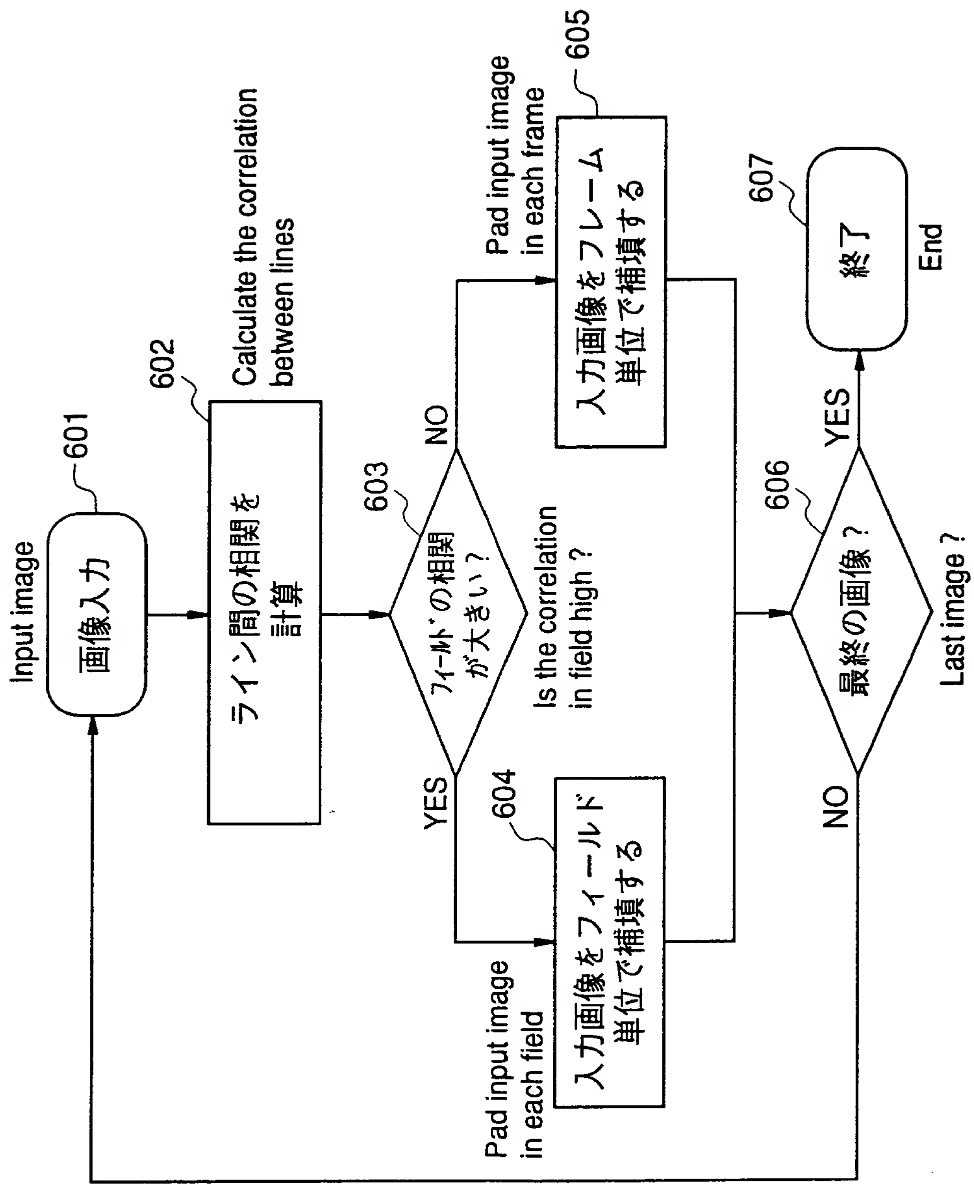


【図5】　Figure 5



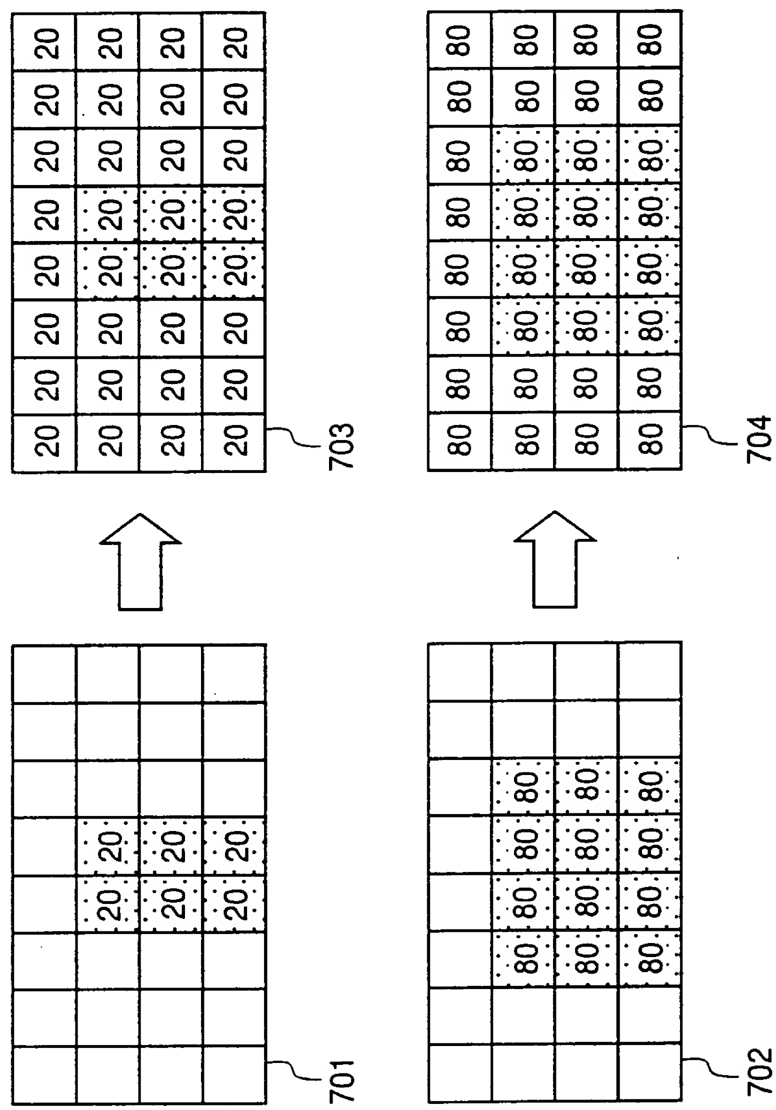
Input image
501
画像入力
502
Calculate the correlation between samples of input image
入力画像のサンプル間の相関を計算
503
Resampling ?
再標本化？
504
Resample input image and pad it
入力画像を再標本し補填する
505
Pad input image as it is
入力画像をそのまま補填する
506
Last image ?
最終の画像？
YES
NO
507
終了
End

【図6】 Figure 6

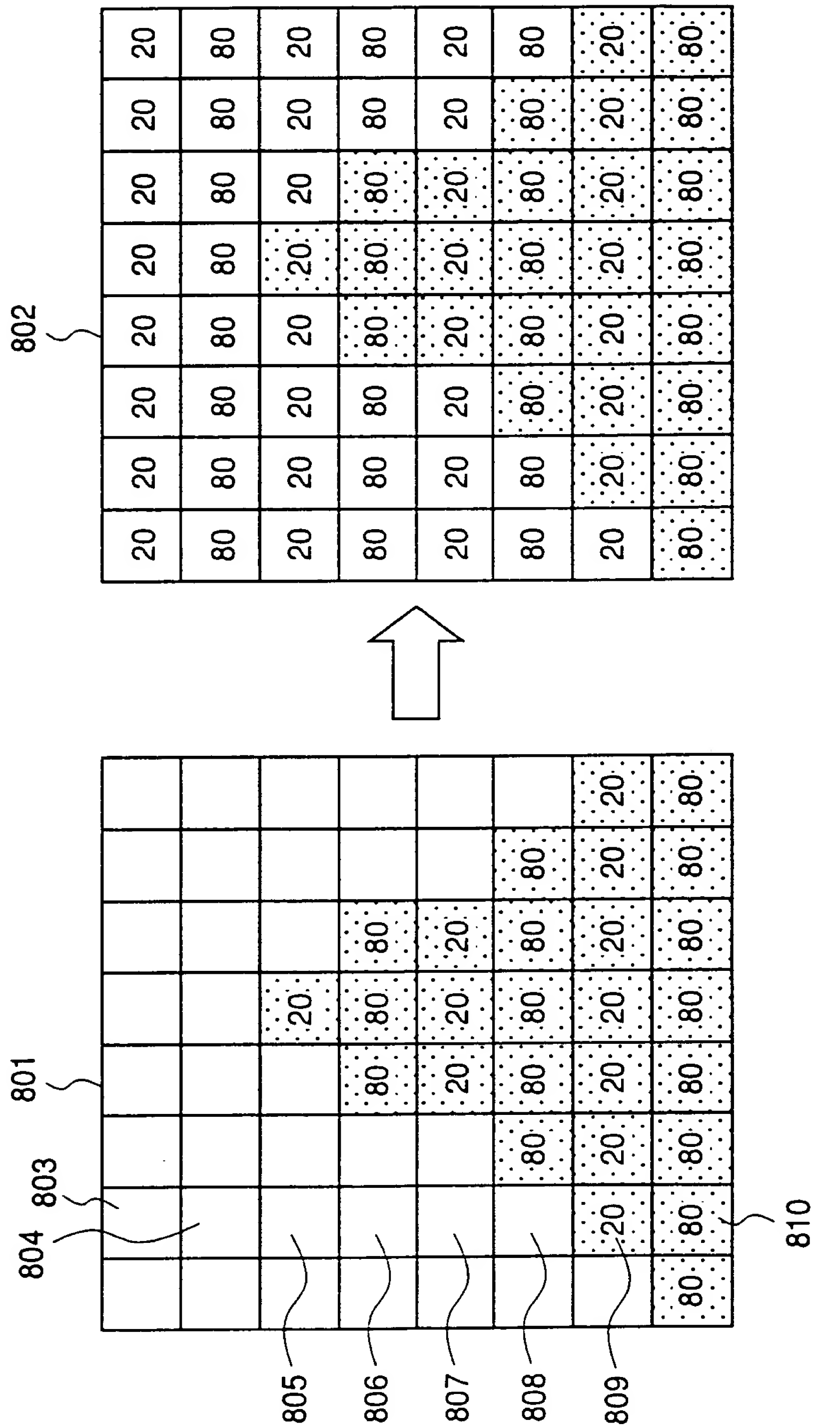


Input image
画像入力
601
602
ライン間の相関を計算
Calculate the correlation between lines
603
フィールドの相関が大きい？
Is the correlation in field high ?
YES
NO
604
入力画像をフィールド単位で補填する
Pad input image in each field
605
入力画像をフレーム単位で補填する
Pad input image in each frame
606
最終の画像？
Last image ?
YES
NO
607
終了
End

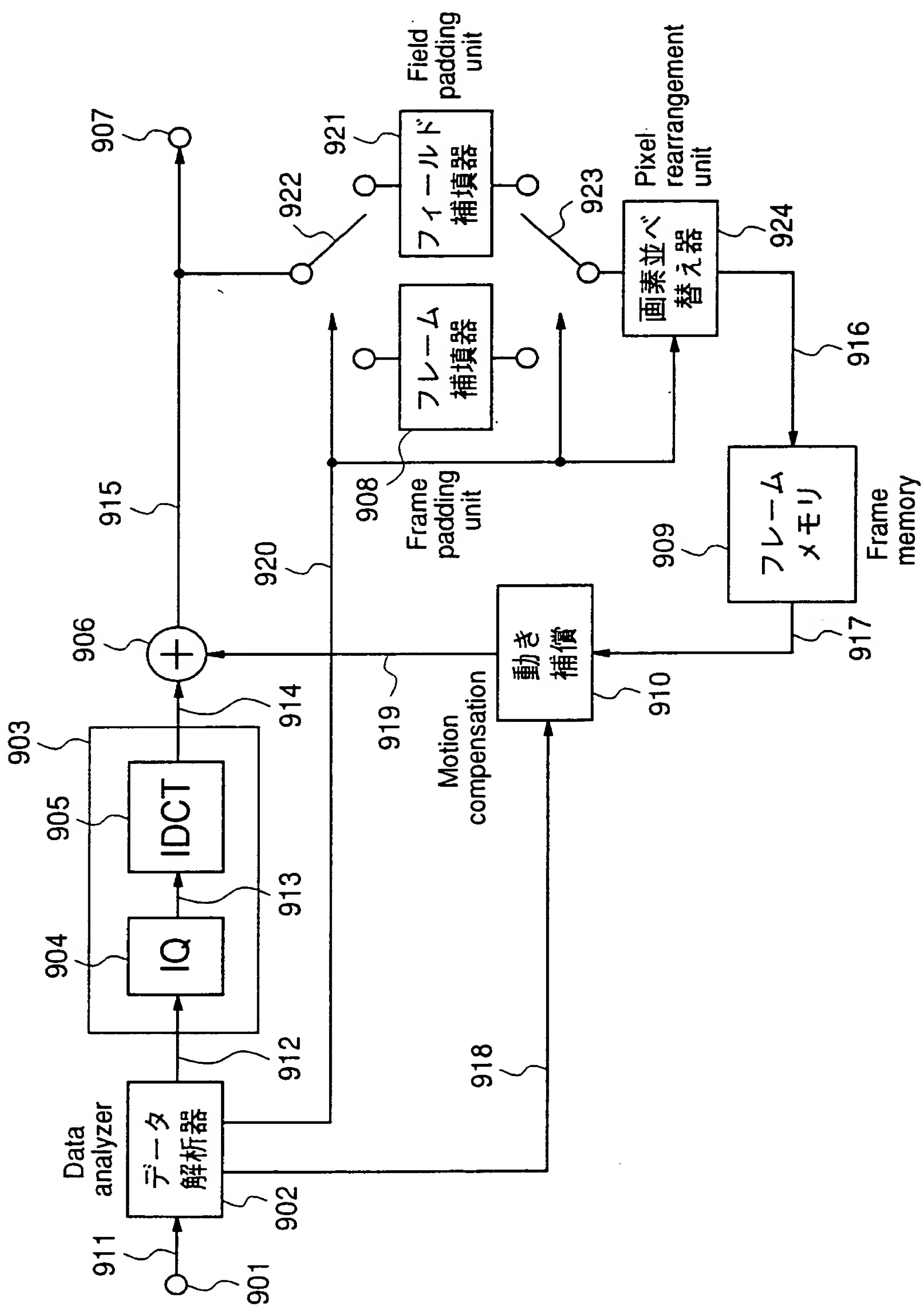
【図7】 Figure 7



【図8】 Figure 8

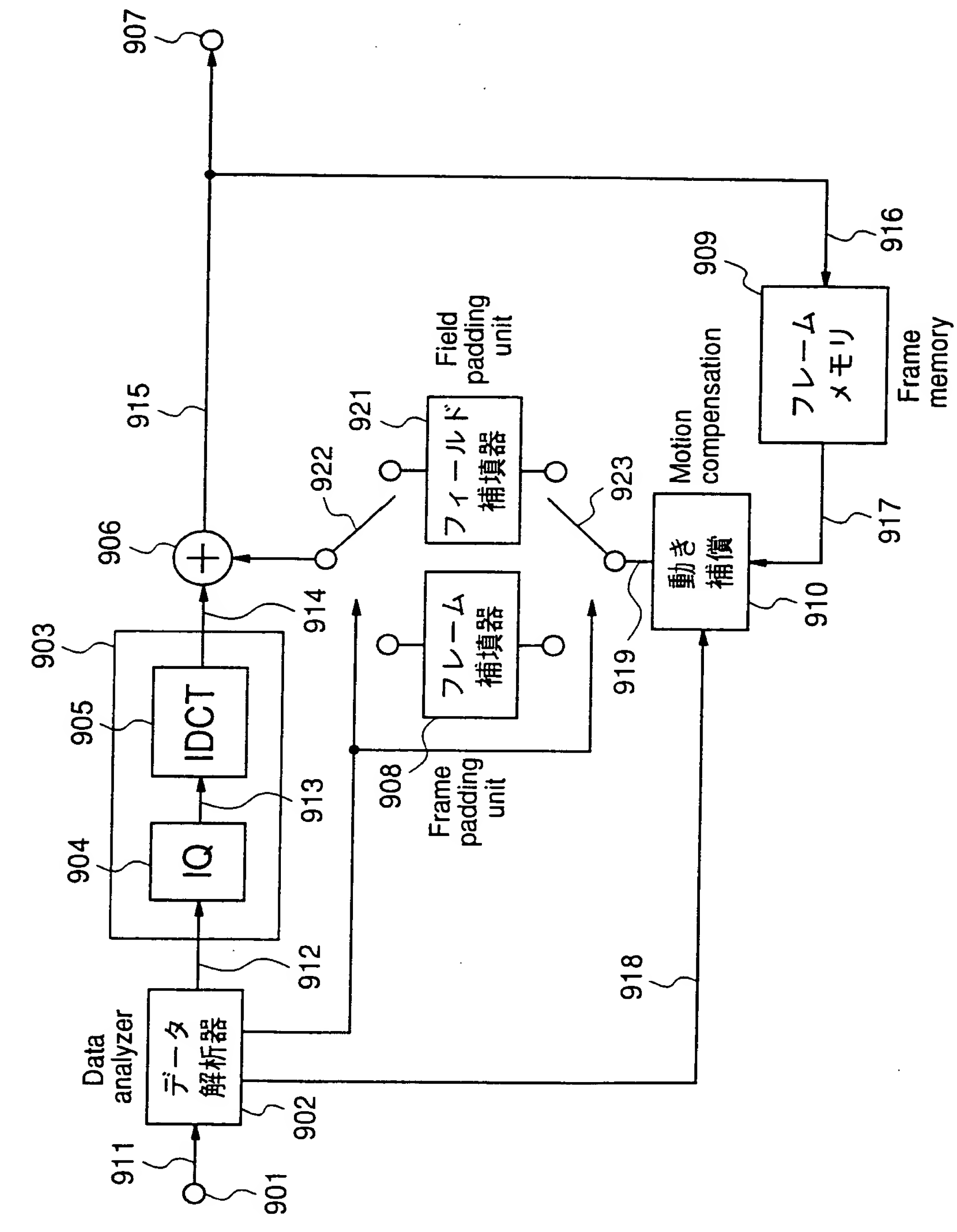


【図9】 Figure 9

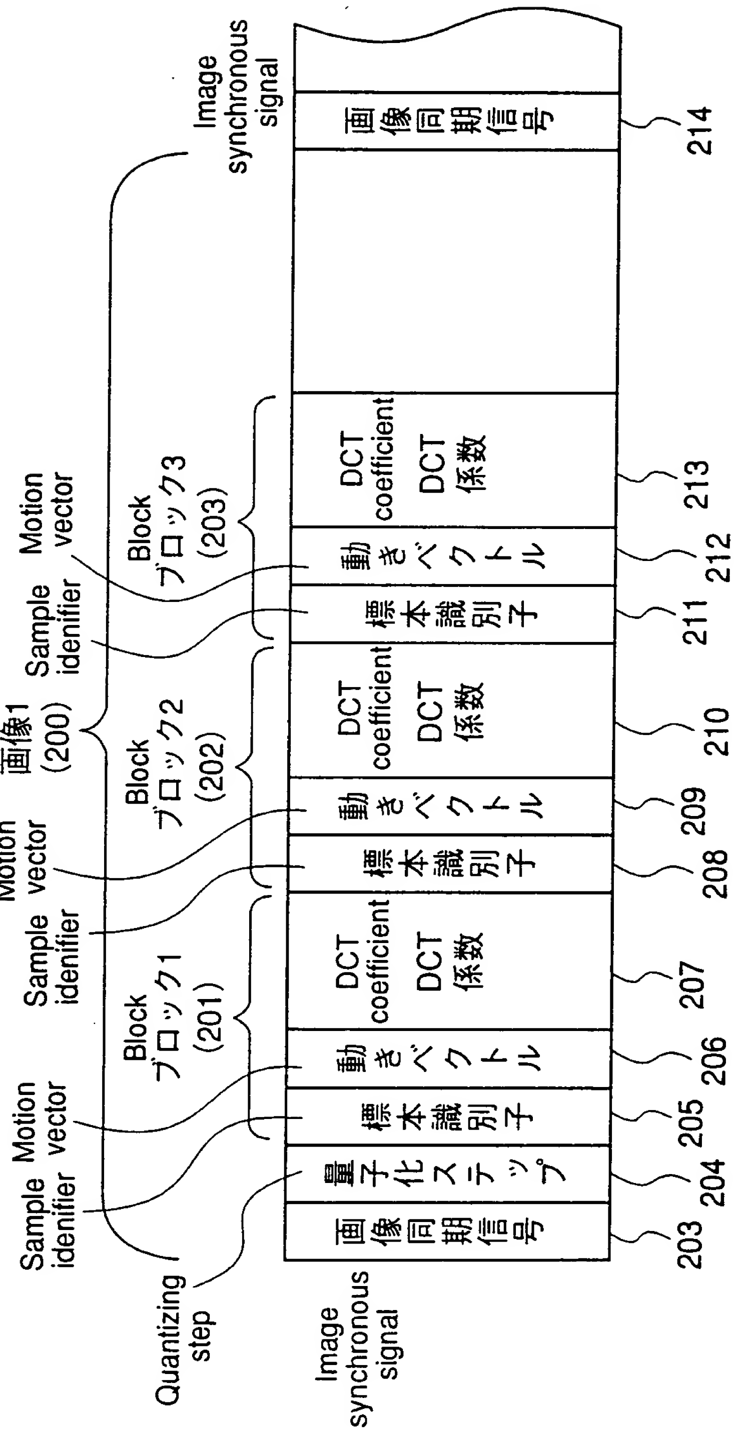


901
911
データ解析器
Data analyzer
902
912
IQ
904
913
IDCT
905
903
914
906
915
907
918
919
動き補償
Motion compensation
910
917
フレームメモリ
Frame memory
909
916
920
フレーム補填器
Frame padding unit
908
922
フィールド補填器
Field padding unit
921
923
画素並べ替え器
Pixel rearrangement unit
924

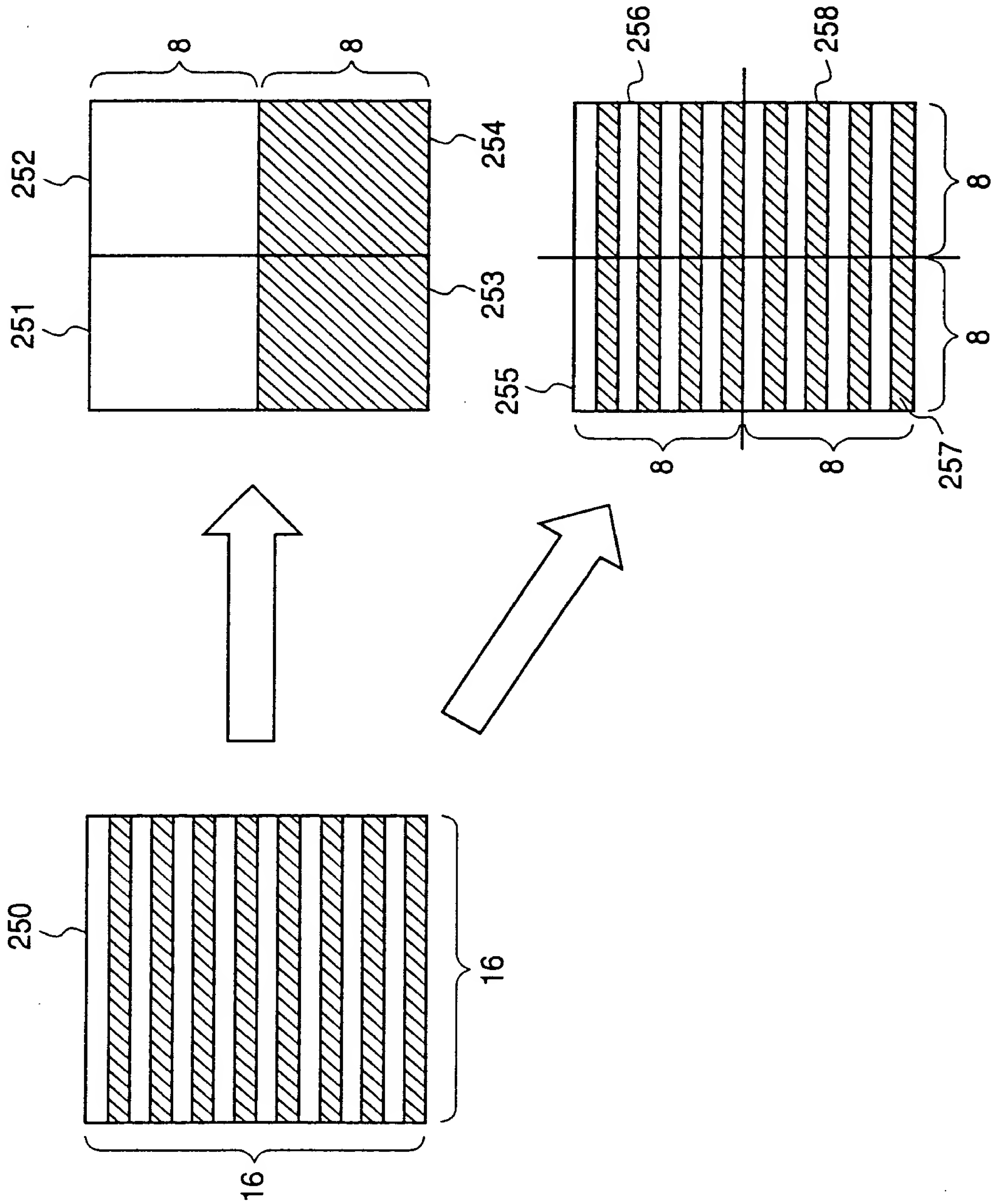
【図10】 Figure 10



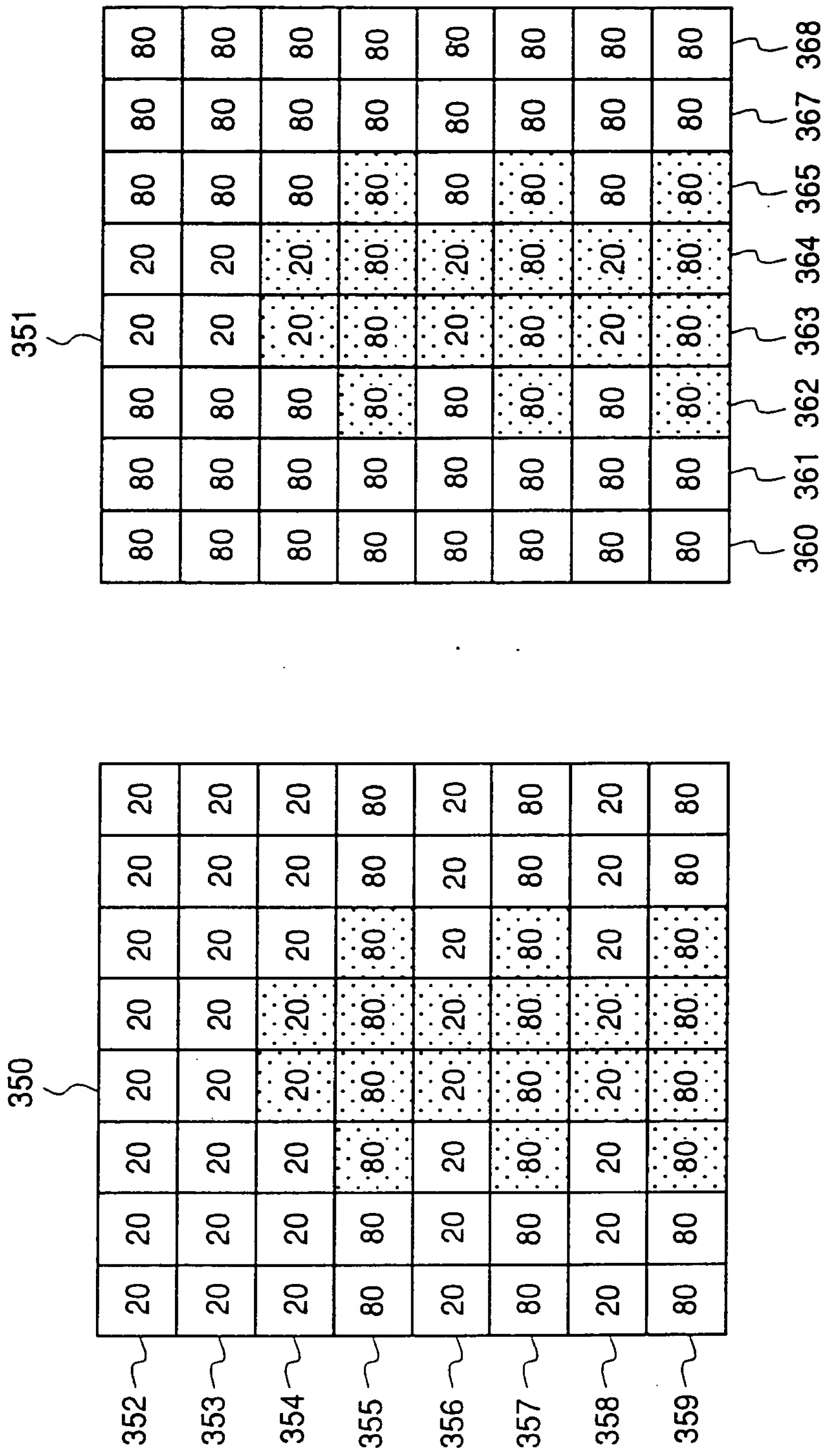
【図11】 Figure 11



【図12】 Figure 12



【図13】 Figure 13



【図14】 Figure 14